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मानक

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Mazdoor Kisan Shakti Sangathan

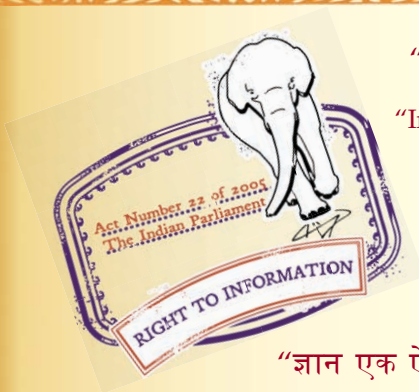
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IS 14700-4-24 (2007): Electromagnetic compatibility (EMC) : Part 4 Testing and measurement techniques, Section 24: Test methods for protective devices for HEMP conducted disturbance [LITD 9: Electromagnetic Compatibility]



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Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

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भारतीय मानक

चुम्बकीय संगतता (ई एम सी)

भाग 4 परीक्षण एवं मापन तकनीकें

अनुभाग 24 एच ई एम पी से उत्पन्न व्यवधान के लिए
संरक्षी युक्तियों की परीक्षण पद्धतियाँ

Indian Standard

ELECTROMAGNETIC COMPATIBILITY (EMC)

PART 4 TESTING AND MEASUREMENT TECHNIQUES

**Section 24 Test Methods for Protective Devices for
HEMP Conducted Disturbance**

ICS 33.100

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BUREAU OF INDIAN STANDARDS
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NATIONAL FOREWORD

This Indian Standard (Part 4/Sec 24) which is identical with IEC 61000-4-24 (1997) 'Electromagnetic compatibility (EMC) — Part 4 : Testing and measurement techniques — Section 24 : Test methods for protective devices for HEMP conducted disturbance' issued by the International Electrotechnical Commission (IEC) was adopted by the Bureau of Indian Standards on the recommendation of the Electromagnetic Compatibility Sectional Committee and approval of the Electronics and Information Technology Division Council.

The text of the IEC Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

- a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.
- b) Comma (,) has been used as a decimal marker while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

In this adopted standard, reference appears to the following International Standard for which Indian Standard also exists. The corresponding Indian Standard which is to be substituted in its place is listed below along with its degree of equivalence for the edition indicated:

<i>International Standard</i>	<i>Corresponding Indian Standard</i>	<i>Degree of Equivalence</i>
IEC 50-161 (1990) International Electrotechnical Vocabulary — Chapter 161 : Electromagnetic compatibility	IS 1885 (Part 85) : 2003 Electrotechnical vocabulary: (Part 85) Electromagnetic compatibility	Identical

Only the English language text in the International Standard has been retained while adopting it as in this Indian Standard, and as such the page numbers given here are not the same as in the IEC Standard.

Indian Standard

ELECTROMAGNETIC COMPATIBILITY (EMC)

PART 4 TESTING AND MEASUREMENT TECHNIQUES

Section 24 Test Methods for Protective Devices for HEMP Conducted Disturbance

1 Scope

This section of IEC 61000-4 deals with methods for testing protective devices for HEMP conducted disturbance. It primarily covers testing of voltage breakdown and voltage-limiting characteristics but also methods to measure the residual voltage under HEMP conditions for the case of very fast changes of voltage (u) and current (i) as a function of time.

2 Normative references

The following normative document contains provisions which, through reference in this text, constitute provisions of this section of IEC 61000-4. At the time of publication, the edition indicated was valid. All normative documents are subject to revision, and parties to agreements based on this section of IEC 61000-4 are encouraged to investigate the possibility of applying the most recent edition of the normative document indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 50(161): 1990, *International Electrotechnical Vocabulary (IEV) – Chapter 161: Electro-magnetic compatibility*

3 Definitions

For the purposes of this section of IEC 61000-4, the following definitions apply:

3.1 **DUT:** Device under test

3.2 **gas discharge tube:** A gap, or several gaps with two or three metal electrodes hermetically sealed so that gas mixture and pressure are under control, designed to protect apparatus or personnel from high transient voltages.

3.3 **primary protection element:** First protective element seen from the unprotected side of a protection measure, diverting the main part of the surge current.

3.4 **protected side:** The side of a protection measure where the equipment is situated that has to be protected.

3.5 **unprotected side:** The side of a protection measure from which the surge event is expected.

4 Test methods for protective devices for conducted disturbance

4.1 General

The actual behaviour of a protective device under HEMP conditions depends very much on how it is integrated in its place of use and other attendant circumstances (e.g. quality of shielding between protected and unprotected side of a protection element). The following test methods take this into account. They are defined so that the results obtained are as far as possible related to the qualities of the device under test (DUT), and the test arrangement does not differ too much from practical protection arrangements. In order to keep this test

standard simple and as universally applicable as possible, the performer is allowed to optimize the test set-up within certain limits but without leaving the range of practical protection arrangements.

4.2 Test set-up

The test set-up consists of pulse generator (G), launching line, test fixture for the DUT, and termination with connecting line and oscilloscope (see figure 1). The characteristic impedance shall be the same throughout the test set-up. If impedances other than 50 Ω are used, they shall be specified.

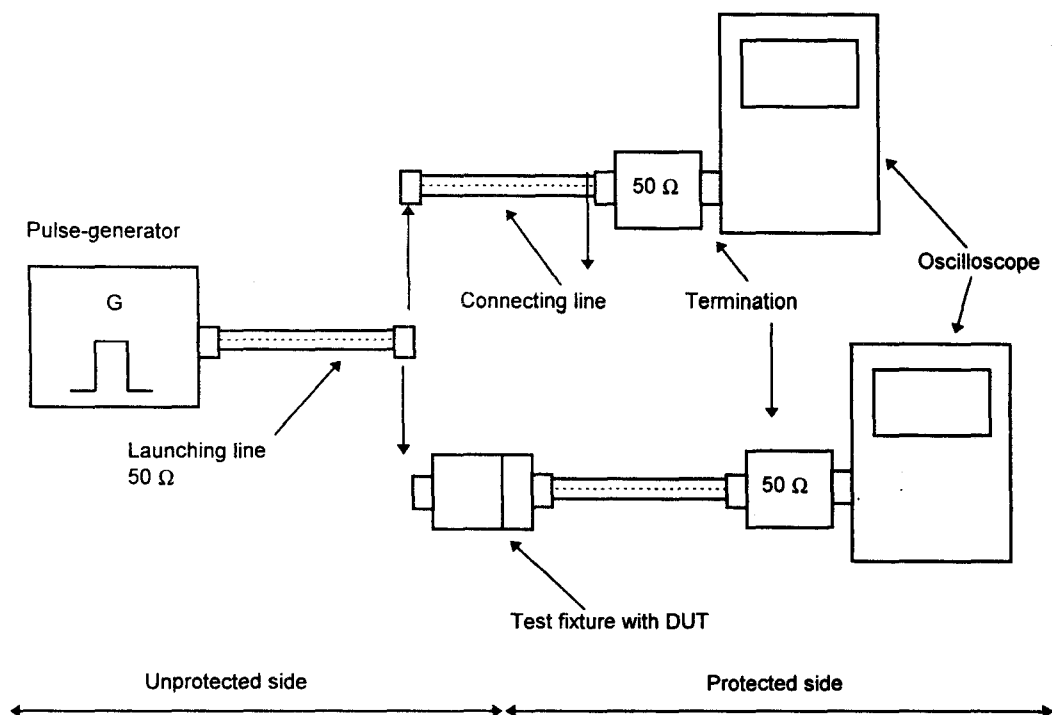


Figure 1 – Test set-up for testing protective devices

To prevent parasitic coupling between the pulse generator and the oscilloscope, both the unprotected and protected side of the set-up must be entirely shielded. It is recommended to use cables with multiple braided wire shields or solid shields. Be sure to use high-quality coaxial connectors with the right characteristic impedance, that can withstand the high-voltage pulses. Be aware of grounding loops.

4.3 Pulse generator

The pulse generator shall have a characteristic impedance of 50 Ω or the value specified. It shall produce a normally rectangular voltage pulse into a matched termination. The front of the wave shall have a rate-of-rise of at least 1 kV/ns at the firing voltage or limiting voltage of the primary protection element of the DUT. The output voltage (into a matched termination) shall be adjustable to a value 2 times higher than the expected limiting voltage of the DUT. Both polarities shall be available. The pulse duration shall be at least 20 ns long.

4.4 Launching line

The launching line consists of a coaxial cable with a characteristic impedance of 50 Ω or the value specified. The cable between the pulse generator and the DUT shall be long enough so that reflections from the DUT do not arrive at the pulse generator during the pulse front. To achieve this condition, the one-way propagation time along the cable must be greater than half the front time of the pulse. Due to the frequency-dependent attenuation of the cable, the steepness of the pulse front may be lowered and thus adjusted to the desired value, by further extending the launching line.

4.5 Test fixture

4.5.1 General

Test fixtures are mechanical set-ups with coaxial connectors on both the unprotected and the protected terminals. Their task is to hold the DUT. Two different types of test fixtures may be used. They are referred to as type A and type B as described below.

4.5.2 Type A fixtures

Gas discharge tubes intended to be used for protection of coaxial high-frequency applications may be tested in corresponding, commercially available holders. The protective device is inserted between the inner and outer conductor of the coaxial set-up, with a minimum of influence on the characteristic impedance. Such holders allow the inherent properties of the device to be measured explicitly and with good repeatability.

4.5.3 Type B fixtures

Type B fixtures are universal and apply in principle to all kinds of two- and four-terminal protective devices, whether they have a feed-through or non-feed-through configuration. However, measurements on low-voltage devices like protective diodes and varistors may be strongly influenced by inductive overshoot due to high di/dt . The results may then be related to the mechanical dimensions of the DUT and its insertion into the test fixture rather than to the inherent qualities of the device.

The fixture is composed of three principal parts: the unprotected shell, the partition screen and the protected shell (see figure 2).

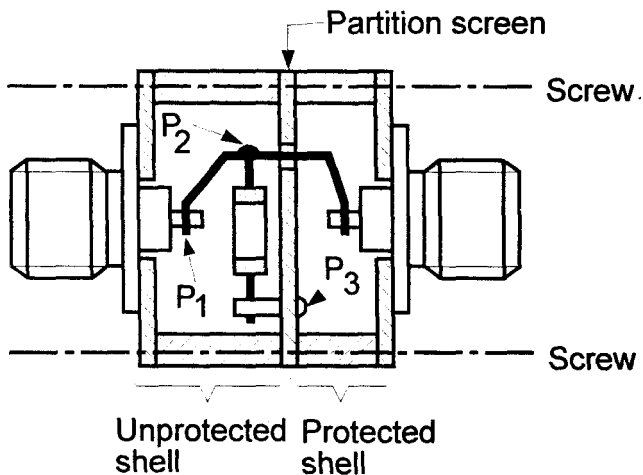


Figure 2 – Example of a type B test fixture with a two terminal DUT in non-feed-through configuration

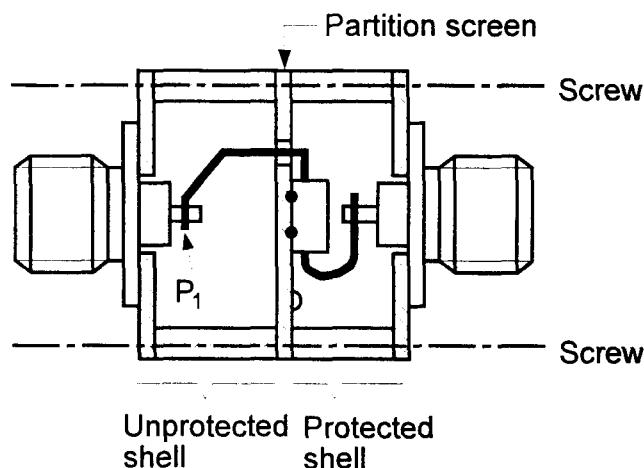


Figure 3 – Example of a type B test fixture with a four-terminal DUT in non-feed-through configuration

Unprotected shell

The interior of the unprotected shell shall have a circular cross-section. Its diameter and length may be adapted to the size of the DUT. The shell may be cut into two parts in the axial direction for better access to the solder points. If not otherwise stated, the length of the wire from the unprotected connector (P_1) to the solder point of the DUT (P_2) shall not be longer than the length of the current path in the DUT between points P_2 and P_3 located in the unprotected shell.

Partition screen

Feed-through protective devices shall be inserted in the partition screen in the same way as in actual application.

For non-feed-through devices, a wire shall pass through a hole as shown in figure 2. The wire or the edge of the hole may be isolated. If not otherwise stated, no feed-through capacitor or other feed-through element shall be used. A non-feed-through DUT may be placed close to the screen but shall not touch it, except if it is assigned for fixation to a metal wall in actual applications (as shown in figure 3).

Protected shell

The protected shell serves as transition to the protected connector. The protected shell shall be made as short as possible. The length of the connection between point P_2 and the protected connector shall be as short as possible.

4.6 Termination

The termination shall be matched to the characteristic impedance of the test set-up within the 3 dB-bandwidth of the oscilloscope. It shall be of the feed-through type, followed by a high-impedance, voltage-dividing probe of the oscilloscope or be part of the first stage of an attenuator in front of the oscilloscope. The line between the test fixture and termination shall have the same impedance as the termination. It shall be as short as possible. Its attenuation shall be less than 0,5 dB at the upper 3 dB cut-off frequency of the oscilloscope. Make sure that the termination withstands the test pulses without degradation.

4.7 Oscilloscope

The bandwidth of the oscilloscope and the other components of the test set-up shall be wide enough that the overall uncertainty of the peak values of u and du/dt due to bandwidth limitations and other system errors is not higher than $\pm 20\%$.

4.8 Test procedure

4.8.1 Adjustment of the pulse generator

The launching line (see figure 1) is first connected directly to the line leading to the termination.

The pulse generator is adjusted as follows:

- a) if the DUT, or the primary protection element of a four-terminal DUT, is a gas discharge tube, the steepness of the leading front of the prospective pulse shall be at least 1 kV/ns at the impulse spark-over voltage of the gas discharge tube during the test;
- b) if the DUT, or the primary protection element of a four-terminal DUT, is a voltage-limiting device (e.g. protective diode or varistor), the highest tangential steepness of the leading front of the prospective pulse shall be

$$du/dt = (1/2) \times Z_c \times di/dt$$

where Z_c is the characteristic impedance and di/dt is the specified value.¹⁾

4.8.2 Verification procedures

The launching line (see figure 1) is then connected to the test fixture.

If a test fixture type B is used, the internal connection between the protected and the unprotected connector shall be tested for its transmission characteristics.

For this purpose the DUT is removed and the same pulse as under 4.8.1 (adjustment of the pulse generator) is applied. The signal measured shall not differ from the one measured under 4.8.1 by more than 10%. If it differs more than 10%, the diameter of the connecting wire should be increased (a higher capacity to ground will lower the characteristic impedance and improve the match between the pulse generator and the load).

To make sure that no undesired coupling between the unprotected and the protected side of the test set-up is present, verification tests shall be made with the following modifications on the test set-up:

If the DUT is a two-lead device, it shall be replaced by a short-circuit connection of the same length and form as the current path through the DUT. The connection between P_2 and the centre-pin of the protected connector (see figure 2) shall be removed. One test shall be made with the centre-pin of the protected connector left open and another one with this pin connected to the ground (within the protected shell).

¹⁾ Note that the specified di/dt corresponds to the actual di/dt in the DUT during the test. As the DUT has a very low impedance compared with 50 Ω or the specified impedance, the current i and therefore also di/dt is doubled during the test.

If the DUT is a feed-through device, it shall be replaced by a device of the same dimensions (dummy DUT) made entirely of well-conducting metal and thus representing an ideal short circuit. The centre-pin of the protected connector shall be connected to the output pin of the dummy DUT.

The peak value of the residual voltage measured under these conditions shall be less than 5% of the peak value measured in the final test.

4.8.3 Test

The dummy DUT is replaced by the DUT, and the residual voltage is measured.

4.8.4 Final examination of the DUT

After the test, the DUT shall be examined for visible damage and its further conformance with the functional and HEMP-relevant specifications. The results of the test shall only be valid if no significant changes occurred.

4.9 Referring to this standard

When reference is made to this standard, the following additional information shall be given.

Standard procedure

- | | |
|--|---|
| – for gas discharge tubes: | type of test fixture used (4.5) |
| – for measurement on two-terminal elements in fixture B: | length of connection wires, see overall length of DUT between solder points (4.5.3) |

Modifications from standard procedure:

- | | |
|---|---|
| – characteristic impedance: | if other than 50 Ω (4.2) |
| – steepness of prospective pulse, du/dt : | if higher than 1 kV/ns (4.3) |
| – actual di/dt : | if higher than 40 A/ns (4.8.1) |
| – modification of DUT: | if connecting wires of gas discharge tubes are cut away for measurement in type A fixture |
| – additional components to the DUT: | circuit diagram with components specified |
| | length of wires if longer than normal |

Annex A
(informative)

Bibliography

IEC 1000-5-5: 1996, *Electromagnetic compatibility (EMC) – Part 5: Installation and mitigation guidelines – Section 5: Specification of protective devices for HEMP conducted disturbance. Basic EMC publication.*

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Amendments Issued Since Publication

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